

Factors Inhibiting Digital Transformation of Indigenous Construction Firms in Nigeria

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Abstract:

Despite the inherent benefits that digitalisation brings to businesses across sectors, indigenous construction firms in developing countries like Nigeria seem unprepared and reluctant to embrace the digital trend. Qualitative research technique was adopted through a case study approach and utilised interviews as the primary source of generating data among eight case companies in Abuja, Nigeria. Data generated were analysed using conversational analysis as a specific data analysis approach in thematic analysis. Findings revealed critical factors inhibiting digital transformation to be lack of funds, shortage of trained professionals, lack of technical know-how, and low level of awareness are the top four factors identified. The paper therefore concludes that overcoming these identified factors is a key to the survival of indigenous construction firms in a globally competitive market and the factors inhibiting the digital transformation of the construction industry in Nigeria are not just limited to one construction firm but could differ from other construction firms. The paper recommends effective partnership among key stakeholders of construction firms to work out an appropriate roadmap that would position the construction industry on the right track toward digital transformation.

Keywords: Digital transformation, Construction industry, Indigenous, Construction firms, Qualitative research, Nigeria

1.0 Introduction

The development of the world economy has been tied to the construction industry, as it contributes 6% of the global gross domestic product [GDP] (World Economic Forum, 2017). The construction industry plays a crucial role in the nation's development, and its continuous development is important for sustainable goals. This development is made possible through digital transformation (Castagnino *et al.*, 2016). This digital transformation and digitalisation are concepts that involve converting traditional methods or construction processes into digitalised processes and transforming information into a digital set of identity. Digital transformation has transformed every aspect of life, from the utilisation of simple devices by humans to a complex industrial system being used by organisations (Dall'Omo, 2017). In achieving efficiency and effectiveness, digital transformation is the right step in the right direction for the construction industry (Building

Radar, 2015). Berger (2016) added that efficient services are delivered with digital transformation in the construction industry. Aghimien *et al.* (2020) had also argued that construction organisations need to possess transformation capabilities relating to technology governance, knowledge management and the creation of new resources and processes to gain a better competitive advantage and transform their service delivery.

Digital transformation is a key concept in the contemporary construction process due to the fact it creates efficiency and effectiveness in design, construction, and operation, among many others (Aghimien *et al.*, 2018). These digital transformations have cut across Europe and Asian construction industries, such that it has digitalised construction processes. Although the construction industry is a latecomer in adopting digital transformation. While, banking, entertainment, telecommunication, retailing, and manufacturing industries have undergone a digital

transformation of their processes, and the results have led to customer satisfaction with the product offered by the respective industries, the construction industry has yet to fully undergo a digital transformation of construction processes, resulting in client dissatisfaction with project delivery. Several factors inhibit this digital transformation. Therefore, the low digital transformation is a result of factors that inhibit the transformation of the Nigerian construction industry. This has affected the performance of the construction industry. Castagnino *et al.* (2016) had argued that no major digital transformation is evident in the construction industry in developing countries. Asuquo *et al.* (2020) observed that digitalisation of the construction industry has been slow but indicated that foreign construction firms have adopted more of these digital tools when compared to indigenous construction firms. Furthermore, digital tools such as the IoT (internet of things), BIM, drones, robots, and cloud computing among others have only become a common idea among construction participants, as a result of increased awareness over time by Building Information Modelling (BIM) (Ibem and Laryea, 2014). However, for construction products and services to be delivered with less effort and higher accuracy, digital transformation among construction stakeholders must change from being just an “idea” to becoming a “standard” (Gerbert *et al.*, 2016). Digital transformation has been projected to revolutionise key life-cycle stages of construction projects (Castagnino *et al.*, 2016).

Despite the benefits of digital transformation in the construction industry articulated by several studies in the past, significant factors have hindered the digital transformation of the construction industry in Nigeria. Several studies have explored digital transformation, digitalisation, and industry 4.0 across the globe (Dale, 2007; Ibem and Laryea, 2014; Ernest and Young, 2015; Gerbert *et al.*, 2016; Berger, 2016; Ezeokoli *et al.*, 2016; Castagnino *et al.*, 2016; Rose, 2017; Consultants to government and industries [CGI], 2017; Aghimien *et al.*, 2018; Osunsanmi *et al.*, 2018; Ofoefule, 2018; Alaloul *et al.*, 2020; Asuquo *et al.*, 2020; Ling *et al.*, 2020; Neuman *et al.*, 2021) just to mention a few. However, several studies have operationalised the factors inhibiting digital transformation in the construction industry based on the peculiarities of its country (Aghimien *et al.*, 2018; Mukwawaya *et al.*, 2018; Bhuiyan *et al.*, 2020; Ling *et al.*, 2020; Alaloul *et al.*, 2020; Moshood *et al.*, 2020). Therefore, there is a need to unravel these factors within the context of Nigeria’s construction industry. To the best of our knowledge, no study examined the digital transformation of indigenous construction firms by taking into cogitation the small and medium-size entrepreneurs (SMEs). The majority of these studies reviewed focused on construction

professionals, while the present study centres on construction firms. The reviewed studies centred on a questionnaire survey, providing a gap in the need for a qualitative research approach. This presents a methodological gap, which the present study intends to fill. In Nigeria, the dearth of studies examining factors inhibiting the construction industry’s digital transformation is sketchy amidst explanatory extend and their benefits to project performance. Therefore, examining factors inhibiting the construction industry’s digital transformation is necessary.

2.0 Literature Review

2.1 *The Concepts and Digitalisation of the Construction Industry and Fourth Industrial Revolution*

Digitalisation is a concept for transforming the production process from an analogue into a digitalised process, where the connection of advanced technologies produces modern competence in enhancing client behaviour (Ernest and Young, 2015). From the construction context, digitalisation refers to the transformation of traditional processes and paper-based practices associated with construction into smart and augmenting construction processes. Rouse (2017) defined digitalisation, as a concept that involves the process of organising, coordinating, unifying and converting information into a well-defined set that is digital in identity. Digitalisation has been projected as a vital process for improving productivity, proficiency in construction processes, efficacy and providing prospects for a construction business to strive (Agimien *et al.*, 2018). Digitalisation of the construction industry offers responsiveness in the global construction marketplace. Ofoefule (2018) posited that digital transformation as a concept that introduces, control, and utilise digital tools to transform vital fragments of a construction firm’s business or operation regardless of the business type and more so. Digital transformation revolves around operations, products/services, employees, and clients/customers.

The main aim of transforming construction industry into a digital one is to make operations digital, through a connection of clients, devices and processes with a view of improving agility, profitability, and overall performance of the industry which helps firms compete for digital clients (Bahl, 2015; Export Management Company[EMC], 2016). Another key aspect of digitalisation is the digital maturity level. However, the digital maturity of the construction business in Africa was ranked the lowest, suggesting that the construction firms/industry needs to change their mode of operation

in this digital era (Oladapo, 2007; Ezeokoli *et al.*, 2016). The majority of players in the construction industry today have identified that digitalisation is gradually affecting every part of the business (Berger, 2016). Digitalisation offers construction firms, ways to improve their overall performance (Osunsanmi *et al.*, 2018). Digital transformation through digital tools and advanced technologies has gained attention since the introduction of BIM (Ibem and Laryea, 2014). For these reasons, Agimien *et al.* (2018) suggested that BIM should be fully implemented in all phases of construction activities.

According to Osunsanmi *et al.* (2018), the digitalisation of the construction industry is construction 4.0. Otherwise known as Fourth Industrial Revolution (4IR), its main essence is the digitisation and automation of the Architectural, Engineering and Construction (AEC) as well as the Facilities Management industry which among others involve the use of robotics and other technologies to deliver different phases in the life cycle of construction projects (García de Soto *et al.*, 2022). One of the major digital technologies that have transformed the ways construction projects are managed is Internet of Things (IoTs). According to Oke *et al.* (2020), it is a network of interconnected devices that are embedded with network connectivity, sensors, software that enable them to amass and exchange data making them responsive. In other words, IoTs embedded in buildings and infrastructure automatically disconnects systems not in use thereby ensuring sustainability. Although, the global construction industry has witnessed unprecedented transformation as a result of the impact of technology, its impact on the construction industry of the developing countries such as Nigeria is unclear. This study examines impediments to full adoption of digitisation in Nigeria's construction industry.

Construction 4.0 utilises advanced and sophisticated technologies that facilitate easy analysis of data and production of construction products that require decision making that could improve the efficacy and productivity of the industry. Construction 4.0 enable firms to capture data and advanced analytics can also improve efficiency, timelines, and risk management (Agarwal *et al.*, 2016). Construction firms need to adopt digital innovations to deliver service with less effort, higher accuracy, and improved productivity (Aghimien *et al.*, 2018). Therefore, the digitalisation of construction firms' operations is necessary for success in the competitive global marketplace. A survey conducted by Berger (2016) showed that digitalisation is about industries experiencing linked systems in the supply chain. Therefore, digitalisation entails the utilisation of digital tools and practices-based ICT. These digital tools and

practices could fundamentally change the way construction works are done (Berger, 2016). Osunsanmi *et al.* (2018) pointed out that one major challenge of digitalisation of the construction industry is the low level of awareness among construction professionals. Ezeokoli *et al.* (2016) posited that low level of technological adoption of information and communication technology. Lastly, no construction firm can succeed in the global construction market, if the goals and operations are not embedded in digital transformation (Halim, 2010).

2.2 Factors Inhibiting Digital Transformation of Indigenous Construction Firms

The digitisation of the construction industry, otherwise known as Industry 4.0 has become a disruptive wave of change that affects the construction industry to the extent that one of the most critical elements is the implementation of the technological revolution (Lekan *et al.*, 2020; Mansour *et al.*, 2021). Several factors have tendered to inhibit the construction industry from attaining this transformation. Fitzgerald *et al.* (2013) highlighted that lack of urgency inhibits construction firms from going digital. Mäkinen, (2017) supported that lack of urgency is a key factor inhibiting digital transformation. This occurs when there is a decrease in awareness of digital opportunities and motivation to pursue a digital goal, which then leads to complacency (Fitzgerald *et al.*, 2013). However, the capacity not to anticipate digital trends affects digital transformation. Ezeokoli *et al.* (2016) added that factors such as managing technological change and lack of adoption of a digital mindset, inhibit the digital transformation of the construction industry. Fitzgerald *et al.* (2013) added that lack of vision, construction firms with no clear direction, vision and goals will find it hard to experience digital transformation (Mäkinen, 2017). Lack of vision has hindered so many companies from going digital (Jadhav *et al.*, 2019), while poor digital culture and low level of digitalisation have posed a threat to the transformation of industries in Nigeria.

Furthermore, the expensiveness and complexity of digital technologies which result in high cost of purchasing and adoption are factors (Deloitte, 2017; Oke *et al.*, 2018). Construction companies that don't invest in digitalisation will lose their competitive advantage (PricewaterhouseCoopers [PWC], 2016). Fitzgerald *et al.* (2013); Ezeokoli *et al.* (2016); Mäkinen, (2017) posited that lack of funds inhibits digital transformation. This was supported by PWC (2016), as digital transformation requires a high level of investment. Fitzgerald *et al.* (2013) further argued that not just a lack of funds inhibits digital transformation but also a lack of resources (manpower). Oke *et al.* (2018) observed that

new technologies are expensive, and the complexity of digital technologies makes them hard to buy and operate as it requires specialised training which makes the digital technologies more expensive to acquire. Digital transformation requires significant capital investment, at least initially, but it is not yet widespread among SMEs, especially indigenous construction firms operating in Nigeria that have difficulty grasping the general knowledge of digital transformation (Vaidya *et al.*, 2018). Lack of adequate infrastructure also poses problems in the transformation of the construction industry. For instance, while electricity and good road networks are key to digital transformation, the Nigerian telecommunication network providers have continued to deliver poor data speed, and interrupted network connections due to infrastructure challenge. Olaitan *et al.* (2021) asserted that shortage of skilled workforce and technological infrastructure plays a key factor in going digital while lack of it poses a serious threat to digital transformation. Meanwhile, Mukwawaya *et al.* (2018) have argued that poor government policy inhibits digital transformation.

The digitalisation of the construction industry raises issues of areas where staff are needed. A survey conducted by Deloitte (2017) revealed that digitalisation of the construction industry will introduce new technical skills, which the construction firms are faced with unavailability of necessary skills. Furthermore, Ezeokoli *et al.* (2016) also revealed that the challenge of shortage of trained personnel. Andrea (2019) observed that high cost of acquiring digital tools and experts to manipulate and operate these machines can be a challenge to an indigenous construction firm, and this could pose more challenges to the existing employees. Lack of employee incentives inhibit the development of employees, with low morale employee are not willing to develop digitally (Ezeokoli *et al.*, 2016). The lack of digital skills and competence in the construction firm's workforce inhibits digital transformation, there is a need to link up with external bodies to provide adequate training on digital technological trends (PWC, 2016). Bhuiyan *et al.* (2020) opined that labour prices make the construction industry unenthusiastic about automation, as it requires a large amount of investment. Nigeria's present labour force lack skills, competence, knowledge, and expertise in the utilisation of IoT, and data analytics among many others. This was supported by Mäkinen (2017) that lack of skills, competence, and capabilities is often the most talked-about factor hindering the transformation of any industry. Ezeokoli *et al.* (2016) also pinpointed that limited availability of the right digital skills and capabilities. There is a need to be equipped with a talented workforce with digital capabilities to support digital transformation, but a lack of adequate skills

hinders digital transformation. An increased skill boosts the improvement of data analytics potentialities (PWC, 2016).

According to Oke *et al.* (2018), lack of training on digitalisation inhibit digital collaboration, not just lack of training but also the cost of digital training. Specific training is needed for retraining existing employees on operating new applications and technologies (Deloitte, 2017). The absence of a digital mindset and digital operations vision, poor senior management support, dearth of digital ethos and training, challenges of interoperability, and poor adaptability of standards were identified as factors that inhibit the digital transformation of indigenous construction firms in Nigeria (Ezeokoli *et al.* 2016; PWC, 2016; Oke *et al.*, 2018). Mäkinen (2017) opined that lack of digital collaboration are important for both business models and product, since it is becoming more complex. There is a need to collaborate with organisations succeeding in digital initiatives. The lack of this collaboration is a challenge. Ezeokoli *et al.* (2016) also suggested that lack of collaboration and sharing culture inhibit digital transformation. A survey by Balfour (2017) observed that IoT and virtual/augmented reality need more resources and increased data usage, this now led to a challenge of increased demand for energy consumption. This results in developing new energy solutions and also ensuring resources are not irrevocable depleted. Osunsanmi *et al.* (2018) asserted that indigenous construction firms are yet to reap benefits associated with digital transformation, which is due to the low level of adoption, as the level of ICT usage is still in the infancy phase. Osunsanmi *et al.* (2018) further stated that low level of awareness of construction professionals on digitalisation affects the growth of the industry. It was further agreed by Ezeokoli *et al.* (2016), that implementation of digital transformation is at embryonic stages, as a result of lack of technical know-how among indigenous construction firms.

The involvement of the internet of things, smart technology, and the interplay of data between the physical and cyberspace has issued a major challenge to data security. PWC, (2016), pinpointed data security concerns could lead to loss of intellectual property. Ezeokoli *et al.* (2016); Oke *et al.* (2018) both observed that security (data security and privacy) become a concern when going digital. Balfour (2017) noted the introduction of smart and digital technologies increases the risks of cyber-attack, and these risks will continue because the construction firms and the industry at large will rely on digital technologies when adopted. Deloitte (2017) the involvement of the internet of things, the internet of service, and data, among others create an

atmosphere to generate new avenues for data theft, attacks by hackers (cyber-crimes), and industrial espionage. Strange and Zucchella (2017) agreed that IoT raises concerns over cyber-security risks. Jadhav *et al.* (2019) noted that cyber security is one of the top five business risks in the global market. Therefore, cyber-attacks have a devastating impact on digital transformation.

3.0 Methodology

The study explored the interpretivism method in examining factors inhibiting the digital transformation of indigenous construction firms. Saunders *et al.* (2009) asserted that qualitative research methods are based on interpretivism of epistemology research philosophy. Interpretivism methods are utilised in examining the depth, richness and complexity of the concerned phenomenon (Wijesinghe, 2011). The study adopted a case study research design. Case study is an empirical investigation that explores a modern phenomenon in its real-life framework, exclusively when the limitations between the phenomenon and the framework are not evident (Yin, 2003). The case study approach under the qualitative research method produces an in-depth result. The study has an attribute of a multiple case study because eight construction firms (four small-scale and four medium-scale enterprises) were studied. Cases of between four and ten are suitable in multiple case studies as it creates room for generalisation of results (Eisenhardt, 1989). The case firms were represented by stakeholders knowledgeable about ICT or technological

innovation. This provided quality data. The study area is in Abuja, Nigeria. Abuja is the capital city of the nation. The population of the study consist of SME construction firms that are registered with the federation of the construction industry. The areas of specialisation of these selected firms centres on engineering, building construction and general contracting. The study adopted the purposive sampling technique which is the most commonly adopted sampling in qualitative research method (Kumar, 2011). The method of data collection for the study was a semi-structured interview which is widely acknowledged for providing enough flexibility to determine unexpected and unanticipated sorts of information (Seaman, 1999). Transcription of the recorded interview was done manually while conversational analysis of the thematic analysis was used for recording themes within the data generated. However, authentic real-life conversations were focused on conversational analysis. Thematic analysis was done to pinpoint, tentative, and record patterns of meaning or themes within data (Braun and Clarke, 2006). Data analysis in the qualitative investigation is to identify patterns, likenesses and variances of the matter studied.

4.0 Results and Discussions

4.1 Indigenous 'Case' Firms Representative

Table 1 designates background information of the indigenous case firms' and firm representatives, ranging from classification of the firm based on SMEs, company areas of specialisation, professional affiliation and working experience in the construction business.

Table 1 Indigenous case firms' representatives

S/N	Indigenous Firms	SMEs	Company areas of specialisation	Profession Affiliation	Working experience
1.	Company A	Medium-scale	Engineering	COREN	30years
2.	Company B	Medium-scale	General contracting	ProQS	28years
3.	Company C	Medium-scale	General contracting	COREN	22years
4.	Company D	Medium-scale	Civil and Building Engineering	ProQS	26years
5.	Company E	Small-scale enterprise	General contracting	NIA	15years
6.	Company F	Small-scale enterprise	General Contracting	CORBON	15years
7.	Company G	Small-scale enterprise	Building Construction	NIA	15years
8.	Company H	Small-scale enterprise	Building Construction	COREN	10years

Table 1 shows the background information of the case firm representative. The interviewees in this context are representative of the case firms and were generally selected to provide rich descriptions of their experiences and are willing to articulate their experiences, thereby providing information that is rich and can challenge and enrich the researcher's understanding. Table 1 specifies the classification of indigenous case firms into the small and medium -scale enterprises. Small-scale construction firms have a staff strength of 11-50, while medium-scale construction firms' staff strength is postulated between $50 < \leq 20$. Companies A, B, C, and D are medium-scaled enterprises, while companies E, F, G, and H are small-scale enterprises. Table 1 also shows the areas of specialisation of the case companies; companies A are into engineering works, companies B, C, E, and F are into general contracting, companies D are into civil and building engineering, while companies G and H are into building construction. The result presented in Table 1 also revealed firm representatives' professional affiliation. In it, companies A, C, and H were represented by the registered Council for Regulation of

Engineering in Nigeria (COREN). Company B and D were represented by a registered ProQS (professional Quantity Surveyor), representatives of company E and G are registered members of the Nigerian Institute of Architects (NIA), while company F were represented by a registered CORBON member (Council of Registered Builders of Nigeria). The working experience of the representative of the case companies is above ten (10) years, making them well knowledgeable in the construction business. The result presented in Table 1 provides a reliable characteristic of the case representatives used for the study.

4.2 *Factors inhibiting Digital Transformation of Indigenous Construction Firms*

There are so many factors inhibiting the digital transformation of construction firms; lack of funds, low awareness, and shortage of trained professionals among many others were revealed by the case companies interviewed as shown in Table 2.

Table 2 Major Findings on the Factors Inhibiting Digital transformation of Indigenous Construction Firms in Nigeria

Information Provider	Key Interview Discoveries	Problems Address
Company A	"The company only encounters one challenge that inhibits the adoption of digital transformation"	The factor revealed was low technical know-how
Company B	"For this company, there are two to three factors that inhibit the adoption of digital transformation"	The factors revealed were lack/low awareness, lack of funds and the infrastructure on which these things are hinged is not there
Company C	"At first the company faced some challenges that inhibit the adoption of digital transformation"	The factors revealed were lack of training, lack of funds, and complexity of these technologies
Company D	"Yes, there are factors inhibiting adoption of any technologies and this company had some share of these factors"	The factors revealed were lack of funds and shortage of trained professionals
Company E	"There are factors at first that inhibit the adoption of digital transformation"	The factors revealed were low technical know-how, low awareness, lack of funds, and expensiveness and complexity of technologies
Company F	"Honestly, the company is facing low adoption due to some factors"	The factors revealed were low awareness, low technical know-how, low adoption, lack of collaboration, lack of funds, and shortage of trained professionals
Company G	"The company is facing low adoption of digital transformation because of these factors"	The factor revealed was a lack of funds (cost of acquiring)
Company H	"The company's low adoption is as a result of these factors, and the factors inhibit the adoption of digital transformation"	The factors revealed were lack of awareness, lack of exposure, and unavailability of enabling environment

Table 2 shows that lack of funds (cost) was revealed by seven out of eight case companies as the factor inhibiting the adoption of digital transformation of their respective construction firms. Company G’ asserted “To be fair and honest is cost; you need a lot of resources (funds, manpower) to deploy the fourth industrial revolution”. Company D’ added “These innovations or should I say digital transformation is capital extensive”. Company C’ also added, “these things are costly, they need a lot of funds to implement because there are not regular things done, so we need to spend more money to implement them”. Company B’ agreed that the cost of getting these things in place is high and lack of incentive is a factor.

Company ‘H’ stated initial cost as one of the factors inhibiting digital transformation stating, “*You don’t give what you don’t have, if the money is not there, there is no way you can go in there to invest into adopting this kind of systems, so cost is number one*”. While companies B, E, F, and H’ agreed that lack of awareness is an inhibiting factor (Table 2). Company B went further to state that lack of awareness is a factor but the infrastructure on which most of these things are hinged are not available. Company H also revealed factors such as lack of awareness, lack of exposure, and unavailability of enabling environment, while company E’ agreed that factors such as low level of awareness, managing digital tools, lack of funds, expensiveness, and complexity of digital tools. Company F’ claimed,

“Generally, one factor affecting us, not just us but the construction industry at large is the low level of awareness to trends of event, since we have a low level of awareness, this then leads to low level of adoption, other factors are lack of collaboration, lack of required skills and capabilities”.

Company ‘C’ opined some firms lack vision in adopting digital transformation. Company C’ claimed these technologies are complex, they are not as easy to implement, “For instance, the RFID has a lot to do with barcoding, and all those stuff, the drones, you need systems, you need laptops, you need servers that will power the drones and make them useful”. Another factor agreed upon was the shortage of trained professionals as companies F, D, and E’ both agreed shortage of trained professionals is a factor inhibiting the adoption of digital transformation (Table 2). However, technical know-how is another factor revealed and was agreed to by companies A, E, and F. Company A’ added,

“I can say one of the factors is lack of technical know-how, especially in terms of the local employees and that is the reason we have a lot of foreign expatriates here and that also brought the issue of training and retraining from time to time so that people will be able to catch up with these technologies”.

Table 3 Cross-Case Analysis of Interview Findings on Factors Inhibiting Digital Transformation of Indigenous Construction Firms

S/N	Similarities of Issues Address	Differences in Issues Address
1.	Lack of funds was common to both SMEs (company B, C, D, E, F, G, and H)	Small-scale enterprises revealed more of a lack of funds when compared to medium-scale enterprise
2.	Lack of awareness was common in the case firm studied (company B, E, F, and H)	Small-scale enterprises revealed a lack of awareness when equated to medium-scale enterprise
3.	Shortage of trained professionals was common for SMEs (company D, E, and F)	Small-scale enterprises revealed a shortage of trained professionals when compared to medium-scale enterprise
4.	Low technical know-how was common to both SMEs (company A, E, and F)	Low technical know-how as a factor inhibiting digital transformation was revealed more by Small-scale enterprise
5.	The expensiveness and complexity of these technologies were revealed by (companies C and E)	No difference

Table 3 revealed the similarities and differences issues addressed between the small-scale and medium-scale enterprises. Lack of funds, low or lack of awareness, shortage of trained professionals, low technical know-how, and expensiveness and complexity of these technologies are common/similar to both small-scale and medium-scale enterprises (Table 3). The key variance between small-scale and medium-scale enterprises on the factors inhibiting digital transformation is the fact

that the factors revealed (lack of funds, lack/low awareness, shortage of trained professionals, and low technical know-how) are more significant to the small-scaled enterprise when associated to medium-scale enterprise.

4.2.1 How have these Factors Affected the Digital Operation of your Construction Firm?

In response to this question, company H’ suggested how the factors have affected the company,

“For instance, I made mention of initial cost, let me say since the money is not there and the banks are not also encouraging you to the invest because always what they look into short term, hardly will you see any financial institution trying to invest in your business in a term of 20-25years, so it makes it difficult, and this has affected the company in terms of production and then the level of competition with other expatriates will deplete, the factors has affected our company in all round.

Company C’ added, “When we need to bring in these systems and processes, you need to start training or else these systems will not be optimally used”. It affects the operation of the company because they need to overcome the shortage of trained professionals and this training is time-consuming. Company E’ explained how the factors affected its company,

“We spent time trying to figure out what we can do, so at one point we sit and look for a way to overcome the factors, so its hamper the digital operation of the company”, having the right thing in place at the right time is time-consuming, you have to send your staff to learn and get trained”.

However, Company F’ gave a straightforward response on how the factors have affected the company,

“We can’t deliver projects on time, operations to slow, we need to fully join the fourth industrial revolution trend or we will be kicked out of the business or we may be dominated”.

Company A’ also revealed how the factor has affected the company, “lack of technical know-how has affected our digital operation because when you have these devices you cannot use it, then it is of no use”. Company D’ posited that competing was a problem and delivering projects on time was a major issue. Company G’ revealed that “Sometimes you may even lose clients”,

while company B’ added that the lack of expatriates is a limitation.

4.2.2 What have been the Critical Challenges or Factors and how has Your Company reacted to them

According to company B’ claimed the major challenge not just for the company but the construction industry generally is government policy (support), the government policy in the sense that there is not enough room for competition. Government agencies handpick foreign companies over indigenous companies, so rather for the indigenous company to be growing or to develop but it looks like they were not patronized, and delayed payment has sent many construction companies out of the business. So, financing a project either by private or government agencies is a problem.

Company D and F’ the largest factor of them all was a shortage of trained professionals, the case companies reacted by bringing in trained professionals. Company F’ further reacted by organizing a series of seminars, and workshops (trained and retraining) for their staff. Companies A, C, and D pointed out low technological know-how as the largest factor. They both reacted the same way, “We needed to bring in foreign expertise, what I mean is we bring in our staff in Europe”, said company C’. Company A’ further added, “That’s why, you discover we still have a lot of these foreigners in the company because the channel more of these innovations, the usage, training, and training from time to time”.

In a similar way, company E claimed the largest factor was shortage of trained professionals and also low technical know-how and the company reacted by sending itsstaff outside the country to learn and research this innovation. The company has invested in research and development and they also bring in foreign expatriate for training and retraining of staff. The cost was the largest challenge to companies G and H’. Company G’ added, “Cost will come in and we find a way to balance it”. Company H’ also added, “If you want to stay relevant, you have to fight to always to get those projects that will increase turnover annually”.

Table 4 Categorisation of Relevant Concepts

S/N	Objectives of the Study	Pattern
1.	Factors inhibiting the adoption of digital transformation under the fourth industrial revolution	Lack of funds, lack/low awareness, shortage of trained professionals, low technical know-how, and expensiveness and complexity of these technologies

Table 4 shows each categorisation of the relevant concepts. The concepts are patterns that were generated from each major finding to the cross-case analysis of the

interview findings of each objective of the study. Table 4.4forms the basis for the discussion of the findings. The findings of this study revealed critical factors inhibiting

the digital transformation of indigenous construction firms in Nigeria, which are lack of funds, shortage of trained professionals, lack of technical know-how, and expensiveness and complexity of digital technology. This finding is similar to Ezeokoli *et al.* (2016) who observed that shortage of trained professionals, lack of digital mindset, poor incentives, inadequate funds, shortage of required skills, low proficiencies, low level of adoption and digital transformation dynamism among managerial teams as factors inhibiting digital transformation. This is also in line with Osunsanmi *et al.* (2018) posited a low level of awareness of construction stakeholders inhibits digital transformation. This study further corroborates with findings from previous work (Fitzgerald *et al.*, 2013; Mäkinen, 2017) that observed lack of funds, and lack of vision as major factors/barriers inhibiting digital transformation. Vaidya *et al.* (2018) agreed digital transformation requires significant capital investment, at least initially but it is not yet widespread among SMEs in Nigeria as a result construction firms (SMEs) encounter glitches grasping digital transformation. The high cost of acquiring digital technologies is a significant finding of this study, and also the right skilled workers to manipulate and operate these digital trends is a challenge as revealed in literature.

However, the expensiveness and complexity of digital technology inhibit digital transformation, this agrees with Oke *et al.* (2018) expensiveness and complexity of digitalisation result in the high cost of purchasing as factors inhibiting digital transformation. This is because new technologies are expensive and complex, this makes it difficult to acquire, operate, and operating them requires specialized training, which led to a very high cost to acquire. Therefore, the need for training and retraining is vital in coping with digital transformation, while lacking training hinders the transformation of the Nigerian construction industry. PWC (2016) suggested there is a need to link up with external bodies to provide adequate training on digital technological trends. Specific training is required or retraining of existing employees on operating new applications, and technologies, this could enable the full digital transformation. Summarily, critical finding shows lack of funds, low level of awareness, shortage of trained professionals, and lack of technical know-how are critical barriers to digital transformation, and it cut across construction firms in Nigeria.

5.0 Conclusion and Recommendations

The study qualitatively investigates factors inhibiting the digital transformation of indigenous construction firms

in Nigeria. Lack of funds (cost of obtaining and operating digital tools), low level of awareness, shortage of trained professionals, and low technical know-how are the critical factors inhibiting the digital transformation of construction firms. The digital transformation of construction firms can be strengthened by improving the significant factors inhibiting the adoption and application of digital tools across construction firms' strata. Based on these results, the study advanced that the digital transformation of the Nigerian construction sector is vital for the survival of any construction firm and the identified factors could differ across construction firms in Nigeria. Overcoming these factors is vital for the survival of the construction industry in Nigeria in this digital era. The finding implies that if construction firms do not prioritize digital transformation, then the projects executed may suffer poor performance and worsen the consequence of project abandonment, this is because digital transformation, transforms key stages of construction projects, as established by (Castagnino *et al.*, 2016). The study recommended digital partnership between software vendors, I.T experts and construction stakeholders for training and retraining of the construction workforce and this would reposition the industry on the right track towards digital transformation. Digital transformation requires a collaborative effort of both government and construction stakeholders. The major limitation of the study is the fact that the case companies were represented by one representative for the interview session, although the interviewee is knowledgeable on digital transformation, however, this presents a possibility of not having a holistic view of the case company could be obtained. A future study could be adopting a focus group as a source of data collection to address the present study's limitation. Also, further research could quantitatively model these factors inhibiting digital transformation.

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